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Original Communication

Massive internal injury in the absence of significant external injury after collisions of passenger vehicles with much larger vehicles

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Abstract

We have encountered cases of motor vehicle collisions in which there was relatively little external trauma, but there were massive internal injuries that were much more extensive than might be expected from the external examination. Two cases were collisions between trains and pickup trucks, the third a collision between a semi trailer and a van. In all three cases, the external examination showed minor abrasions and lacerations. Internally, however, there were massive injuries which were fatal. While the significant injuries in our cases were not surprising given the force of the collisions involved, it is interesting that the external examination showed relatively little injury. We speculate that collisions between passenger vehicles and very large vehicles generate massive internal injuries by transmission of force through the victims.

Keywords: Train; Semi trailer; Autopsy; Collision; Truck

1. Introduction

Fatalities in motor vehicle accidents are common cases encountered in the practice of forensic pathology. In our experience, such fatalities are often characterized by obvious extensive external trauma, including lacerations, abrasions, hemorrhage, and fractures. In addition to these external injuries, there is usually significant internal trauma. Most of these cases involve passenger vehicles of average size (2–4 passenger capacity) that collide with comparable vehicles or fixed objects on the road. Such collisions may provide significant intrusion of the oncoming vehicle or parts of the decedent's vehicle into the seating areas, allowing intrusive parts to inflict visible external injury. Also, the seating areas may collapse and crush the driver or passenger, thus inflicting obvious external injury.

We recently encountered three cases in which there was relatively little external trauma noted by the scene investigators and external examination. However, autopsy confirmed massive internal injuries which were fatal, and which were much more extensive than we expected from the degree of obvious external injury. There were similarities between the three cases, too, in that they all involved relatively large, sturdy passenger vehicles (two trucks and a van) which collided with much more massive commercial vehicles (two trains and a semi trailer). We report these cases, and speculate on the etiology of this similar pattern of trauma in the three decedents.

2. Case reports

2.1. Case 1

The decedent was a 58-year-old white male. He stopped his large pickup truck at a set of ungated railroad tracks as the warning lights indicated an approaching train. He was wearing a seat belt. When the train was within view, he pulled his truck onto the tracks, stopping with the cab of his truck in line with the oncoming train. The conductor

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of the train saw the truck on the tracks and started braking, but was not able to bring the train to a stop, only to slow it to 41 mph. Just before collision, the driver of the truck made eye contact with the conductor. The train struck the truck on the driver's side. The train hit the truck broadside, bending the frame of the truck and entering the cab. The collision severed the truck driver's seat belt and displaced him to the passenger side. The vehicles locked and the train rammed the truck 400 yards along the tracks until the vehicles came to a stop.

The body of the driver was that of a heavyset middle-aged white male. The normocephalic head showed minimal gross trauma, but palpation demonstrated crepitus in the posterior left temporal and occipital areas. There was hemorrhage arising from both ears (Fig. 1). The right orbit was swollen. There were abrasions on the superior right chest, and a broad and roughly triangular-shaped area of abrasion on the left posterior shoulder and dorsum. There were no visible fractures of the chest or extremities.

Internally there was massive trauma. When the scalp was reflected, multiple skull fractures were found, from which cerebral tissue focally exuded (Fig. 2). The skull base also showed multiple fractures. There was extensive intracranial hemorrhage which included the ventricles. There was atlanto-occipital dislocation. The bilateral ribs were fractured anteriorly and posteriorly. The chest cavities were filled with blood. The pericardium was torn and the heart was displaced into the left chest cavity. The right lobe of the liver was severely lacerated. The pubic bones were separated at the symphysis pubis. The bladder was ruptured.

Microscopically, there were hemorrhages in the brain, lungs, and liver. The heart showed mild atherosclerotic disease. The other organs were histologically intact.

The blood alcohol concentration was 162 mg/dL. A drug screen was negative.

2.2. Case 2

The decedent was a 50-year-old white male. The circumstances of the collision are not clear, as it occurred before dawn and was not witnessed. The decedent apparently drove his pickup truck into the path of a moving train which had already been on the tracks for several minutes, and was traveling through an ungated, unlit railroad crossing. The truck struck a car in the middle of the train. The conductor was unaware of the collision, as it did not displace the train or slow its travel. The decedent was not wearing a seat belt, although the air bag in the front seat was deployed. The train was coming from the left relative to the truck. The truck struck the train broadside. On collision, the front of the truck was shorn from the cab and bed, and the severed parts were dragged 150 yards down the tracks until they were deposited on the ground. The collision displaced the driver to the passenger side of his truck. He was dead at the scene.

Fig. 1. Case 1. The head externally showed very minimal trauma. However, the presence of blood in both ears was suspicious for skull base injury.

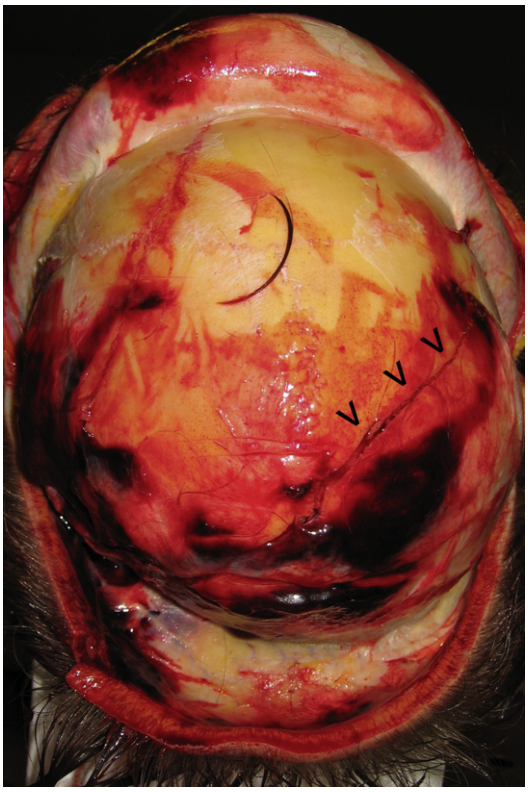

Fig. 2. Case 1. Deflection of the scalp showed diffuse hemorrhage and several skull fractures. Opening the skull confirmed the presence of skull base fractures.

The body of the driver was that of a large middle-aged white male.

The head showed ecchymoses and abrasions of the right frontal and bilateral supraorbital areas, right hand, and left anterior distal extremity. Lacerations were noted on nose, right cheek, and right knee. There were ecchymoses on the superior right chest (Fig. 3).

Internally, however, there was massive trauma. The head showed a right skull base fracture. The bilateral ribs were fractured anteriorly. The chest cavities were filled with blood. The pericardium was torn and the heart was displaced into the left chest cavity. There was a full-thickness laceration of the heart (Fig. 4).

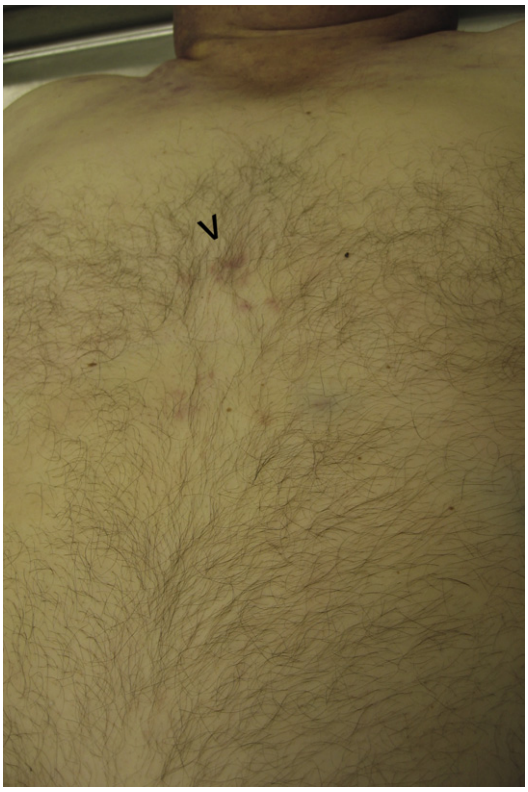

Fig. 3. Case 2. Mild ecchymoses were identified externally on the chest of this decedent.

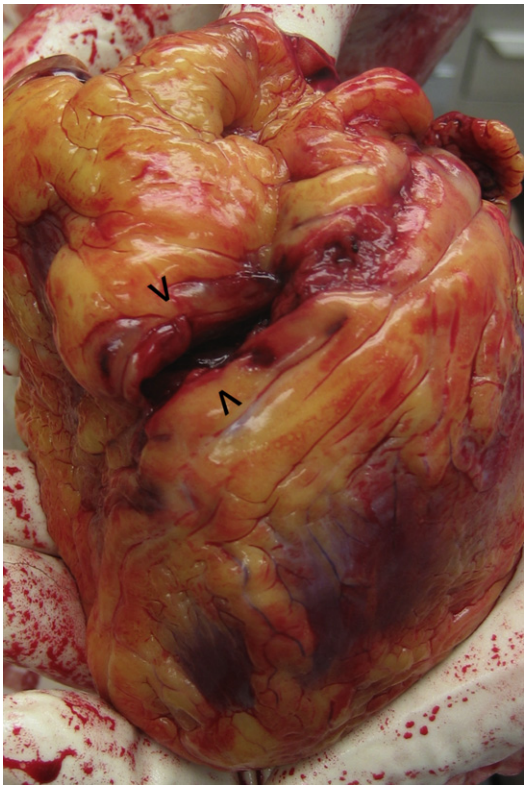

Fig. 4. Case 2. Opening the chest showed many broken ribs, torn pericardium, and a lacerated heart with concomitant massive hemothorax.

Microscopically, there were hemorrhages in the brain, lungs, and liver. The heart showed focal marked atherosclerotic disease. The other organs were histologically intact.

The blood alcohol concentration was negative. A blood drug screen was also negative.

2.3. Case 3

The decedent was a 32-year-old black male who was the driver of a van on a four-lane highway in the winter. He was driving approximately 55 mph and was restrained by a seat belt. His vehicle slid on an icy four-lane highway, spun, crossed the midline, and was struck broadside by a semi trailer, which was also moving at approximately 55 mph. The semi trailer struck the van on the passenger side with significant intrusion into the driver's compartment. The vehicles locked and the semi rammed the van approximately 100 yards before the vehicles skidded to a stop in the snow on the side of the road. The driver of the van was dead at the scene of the accident, while the driver of the semi sustained no physical injuries.

The body was that of a heavyset young black male. The normocephalic head showed trauma on the left upper lip, which was lacerated. There were abrasions on the left cheek, chest and medial left ankle. Otherwise the body showed no significant external trauma.

However, the internal examination showed massive trauma. The bilateral ribs were fractured anteriorly and posteriorly, and the sternum was transected. The chest cavities were filled with blood and blood clot material. There was a tear in the pericardium, and a 2 cm laceration of the aortic arch. The right hemidiaphragm was torn and the lacerated liver erupted through the diaphragm into the right thoracic cavity (Fig. 5). These lacerations were massive, nearly transecting the liver. When eviscerated, transections of the thoracic spine and aorta were observed. There were no fractures of the skull, but there was a pontine and cerebellar subarachnoid hemorrhage.

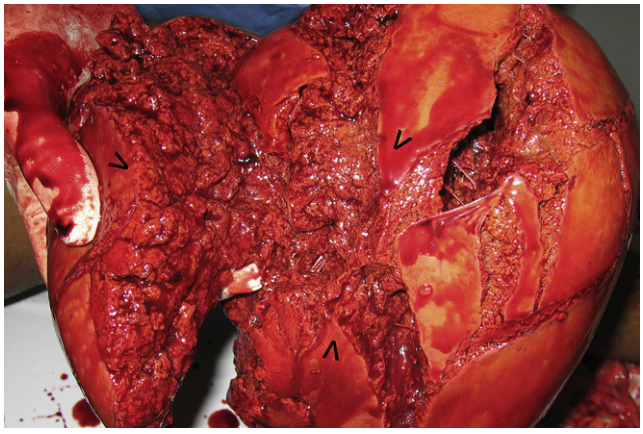

Fig. 5. Case 3. Massive chest and abdominal trauma in the absence of significant external injury included this diffusely lacerated liver.

Microscopically there were hemorrhages in the lungs. The heart showed mild cardiovascular disease. The liver showed marked diffuse fatty change. The rest of the organs were histologically intact.

The urine drug screen was negative, as was the blood alcohol concentration.

3. Discussion

The present cases showed fatal internal injuries which were much more extensive than was obvious externally. In all three cases, there were collisions between sturdy passenger vehicles, namely trucks and a van, with very large vehicles, trains and a semi trailer, respectively. Two cases were suicides and the third was an accident. All cases involved collisions at high speeds with generation of enormous force from impact and rapid acceleration or deceleration. The drivers were not crushed by the colliding vehicles, but were displaced from their restraints and died immediately from very similar massive internal injuries.

In surveys of injuries and deaths from accidents with trains, most cases are not collisions between a train and a vehicle, but between a train and a person.[1,2] The typical person–train accident is a commuter who falls from a train, a pedestrian who is hit by a train while crossing the tracks, or a person who makes a deliberate suicide attempt.[1,2] The typical victim of an accident with a train is a male, age 25–44, and is often intoxicated.[1–3] Fatalities are common, but some people survive accidents with trains.[1,2] Most survivors and decedents, however, experience significant trauma with extensive disruption of more than one body region.[1–4] Significant lacerations of the liver and transections of the aorta are commonly seen in the victims of these collisions.[3,4] Incidents involving trains and cars are relatively rare,[1,2] and suicides like two of the present cases, in which a man drives his car onto the tracks of an oncoming train, are most unusual.

In contrast, accidents between passenger vehicles and semi trailers are more common than those with trains. There is no typical profile of the person involved in this kind of accident. Fatalities in these collisions are frequent.[3,5] The forces involved in the accident are very high, and often involve oblique or perpendicular collisions, as in the present case.[5] Internal injuries such as liver laceration and aortic transection are common in the victims of these collisions.[3–5] Aortic transections are often multiple, and appear to be due to the mechanism of rapid deceleration and chest compression.[5]

While the significant injuries in our cases were not surprising given the force of the collisions involved, it is interesting that the external examination showed relatively little injury. We speculate that collisions between passenger vehicles and very large vehicles generate massive internal injuries by transmission of force through the victims. Perhaps the passenger vehicles the decedents drove provided some protection from external injury. The passenger vehicles buckled and were severely damaged. The drivers were displaced from their seating, thus experiencing minor abrasions and lacerations, but there was no direct crushing or impact of the colliding vehicles with the decedents' bodies, and thus relatively little external trauma. However, the massive shock wave generated by the collision may have been transmitted through the drivers, inducing shearing forces which inflicted the extensive internal injuries.

The present cases also demonstrate the importance of obtaining an autopsy in fatalities from collisions between passenger vehicles and large vehicles, as the type and extent of internal damage may not be externally obvious.

References

1. Spaite D, Criss E, Valenzuela T, Meislin HW, Ogden JR. Railroad accidents: a metropolitan experience of death and injury. *Ann Emerg Med* 1988;**17**:620–5.
2. Lerer LB, Matzopoulos RG. Fatal railway injuries in Cape Town, South Africa. *Am J Forensic Med Pathol* 1997;**18**:144–7.
3. Moar JJ. Traumatic rupture of the thoracic aorta. An autopsy and histopathological study. *S Afr Med J* 1985;**67**(9):383–5.
4. Moar JJ. Autopsy assessment of liver lacerations. A study of 62 cases. *S Afr Med J* 1985;**68**(3):180–2.
5. Shkrum MJ, McClafferty KJ, Green RN, Nowak ES, Young JG. Mechanisms of aortic injury in fatalities occurring in motor vehicle collisions. *J Forensic Sci* 1999;**44**:44–56.